TITLE

A TIRE MOUNTING DEVICE AND METHOD

Background of the Invention

Field of the Invention

The disclosed invention relates to machines and devices for mounting tires on wheels and, more particularly, methods and apparatus for mounting pneumatic tires on rigid wheels.

Description of the Prior Art

Many types and styles of tire mounting machines and tools are known in the prior art. Various examples of tire mounting machines are shown and described in U.S. Patent Nos. 3,958,618; 5,826,319; 5,678,621; and 4,969,499 in which the wheel is mounted on a table and rotated angularly with respect to tire mounting tools. In some cases, the tire is secured as a fixed position such as shown in U.S. Patent No. 4,830,079. In other cases, the tools are mounted in a fixed position and the wheel and tire are rotated such as shown in U.S. Patent Nos. 5,088,539 and 4,784,203. Still other patents such as U.S. Patent Nos. 6,145,566; 6,273,171; 6,453,971; 5,472,034; 4,133,363; 4,529,024; and 5,232,035 disclose various modifications for tools that are used to mount tires.

In all of these prior art schemes, tires are mounted according to the method whereby the bead of the tire is passed over the bead retaining rims of the wheel by causing a mounting tool to travel in an angular direction with respect to the wheel so as to stretch the bead of the tire over the bead retaining rim. It takes substantial time to mount a tire according to this method. Furthermore, as documented in several of the cited references, this method requires a distortion of the tire that can sometimes damage the tire. Accordingly, there was a need in the prior art for

an apparatus and a method of mounting tires on a wheel that would be faster and that wold also be less prone to damaging the tire.

Summary of the Invention

In accordance with the presently disclosed tire mounting device and method, a mounting table secures a wheel while a pivot arm grips an angular sector of a tire and moves the tire into partial engagement with the wheel. The pivot arm initially positions the tire on the wheel such that the wheel partially protrudes through the center aperture of the tire. The pivot arm is then moved radially with respect to said wheel so that the inner and outer beads of said tire within said angular sector contact said wheel laterally between the inner and outer bead retaining flanges of the wheel. A press arm is then moved against a second angular sector of the tire. The second angular sector is located on the tire at an angular position that is substantially opposite from the angular position of the first angular sector. The press arm forces both the inner and outer beads of said tire within said second angular sector to pass one of the inner or outer beads retaining flanges of said wheel. The pivot arm then releases the first angular sector of the tire and the press arm moves away from contact with the second angular sector of the tire to allow the tire to return to its initial shape.

Preferably, the tire is inflated after it is released by the pivot arm and the press arm. Also preferably, the pivot arm has a clamp at one end that clamps the first angular sector of said tire to secure said tire therein. Also preferably, the pivot arm pivots between a first position where said clamp secures the first angular sector of the tire, and a second position wherein the pivot end of the gripper arm is advanced radially toward the wheel that is mounted on the table.

Other details, objects and advantages of the subject invention will become apparent to those skilled in the art as a more detailed description of a presently preferred embodiment thereof and a presently preferred method for practicing the same proceeds.

Brief Description of the Drawings

A presently preferred embodiment of apparatus according to the disclosed invention and a method for practicing the same is shown and described in connection with the accompanying drawings wherein:

Figure 1 is a side view of the disclosed tire mounting device wherein the pivotal arm is in an initial angular position with the fingers thereof are in an open position and wherein the press arm is raised.

Figure 2 shows the tire mounting device of Figure 1 wherein the pivotal arm is in a vertical position with the fingers closed on an angular sector of a tire;

Figure 3 shows the tire mounting device of Figures 1 and 2 wherein the pivotal arm is partially pivoted toward the mounting table;

Figure 4 shows the tire mounting device of Figures 1-3 wherein the pivotal arm is fully pivoted in the direction of the mounting table; and wherein the pivotal arm is located at a position that is away from the mounting table;

Figure 5 shows the tire mounting device of Figures 1-4 wherein the pivotal arm is fully pivoted to the mounting table and wherein the pivotal arm is positioned radially adjacent to the mounting table;

Figure 6 shows the tire mounting device of Figures 1-5 wherein the press arm of the device is lowered to contact the tire;

Figure 7 shows the tire mounting device of Figures 1-6 wherein the press arm is further lowered so as to draw the inner and outer beads of the tire over the upper bead retainer wall of the wheel; and

Figure 8 shows the tire mounting device of Figures 1-7 wherein the pivotal arm is retracted and the fingers of the pivotal arm are released and the press arm is also retracted to allow the tire to return to its natural position.

Description of a Presently Preferred Embodiment of the Disclosed Invention and Method for Practicing the Same

A presently preferred embodiment of the disclosed invention and a method for practicing the same are shown and described in connection with Figures 1-8 wherein a tire 20 is shown mounted on a wheel 22. Tire 20 is of a conventional pneumatic type tire wherein a tread surface 24 defines the outer perimeter of tire 20. An inner side wall 26 is joined to one edge of the tread 24 and an outer side wall 28 is joined to the opposite edge of the tread. Side walls 26 and 28 have terminal bead surfaces 30 and 32 respectively which together define the inner porthole 33 of the tire 20.

Wheel 22 is also of a conventional type that is in the general shape of a rigid spool that rotates about an axis 34 and has a radial dimension 36. In a cross-section of wheel 22 taken along axis 34, the outer perimeter surface 38 of wheel 22 defines a well 40 that is located at an axial position between an inner bead retainer wall or flange 42 and an outer bead retainer wall or flange 44.

In the preferred embodiment of Figures 1-8, the tire mounting device includes a frame 46 to which other components of the device are secured. The device further includes a mounting table 48 having a mounting surface 50. In the presently disclosed embodiment, mounting table 48 is shown as a stationary table that is directly secured to frame 46. However, it will be readily apparent to those skilled in the art that alternative embodiments that are also within the scope of the invention herein disclosed include various types of conveyor lines having a number of work stations that are successively indexed to a working position relative to frame 46. As another alternative, mounting table 48 could also be in the form of a continuous conveyor having a plurality of work stations with the other components of the tire mounting device being secured to frame 46 in a translatable manner so that the tire 20 can be mounted to wheel 22 as wheel 22 continuously moves with respect to frame 46. Such alternatives are within the knowledge of one skilled in the art and are not further detailed herein.

Preferably, mounting table 48 includes a mechanism for securing the wheel 22 to the mounting table 48. An example of such a mechanism is shown in Figures 1-8 as a chuck 52, although alternative mechanical fastening devices such as are known in the prior art could also be used.

A gripper arm or pivot arm 54 is connected to frame 46 at a location adjacent to mounting table 48. Pivot arm 54 moves tire 20 from a first location that could, for example, be a tire supply conveyor, to a second location in which the tire 20 is partially engaged with the wheel 22. More specifically, the inner and outer bead surfaces 30, 32 within an angular sector $\varnothing_1$ of tire 20 are located in well 40 of wheel 22 as hereafter is more fully explained. In the disclosed embodiment, pivot arm 54 has a pivot end 56 that is secured to frame 46 through a pivot joint 58 at a location that is laterally adjacent to mounting table 48. Pivot end 56 and pivot joint 58 are laterally moveable with respect to said mounting table 48. As shown in Figures 1-4, at one limit of travel, pivot end 56 and pivot joint 58 are at an open position in which they are at the maximum lateral distance from mounting table 48. As shown in Figures 5-7, at the opposite

limit of travel, pivot end 56 and pivot joint 58 are at a closed position in which pivot end 56 is laterally closer to mounting table 48.

Pivot arm 54 further includes a grip end 60 that is oppositely disposed on pivot arm 54 from the pivot end 56. Grip end 60 includes fingers 62 that are spaced apart from each other and that close together and move apart in response to pneumatic actuators. Alternatively, other types of power actuators such as hydraulic actuators can also be used. Fingers 62 move between an open position and a closed position. In the open position as shown in Figures 1 and 8, the separation between fingers 62 in a normal direction is a dimension that is greater than the width of tire 20. In the closed position as shown in Figures 2-7, the normal separation between fingers 62 in a normal direction is a dimension that is less than the width of tire 20. Thus, when fingers 62 are in the open position, a tire 20 can be inserted therebetween and when fingers 62 are in the closed position, they secure tire 20 therebetween.

As more particularly shown in Figures 1-4, pivot arm 54 clamps an angular sector of tire 20 and pivotally moves between a first position as shown in Figure 1 and a second position as shown in Figures 4-7. In the first position, pivot arm 54 is angularly oriented with respect to the mounting surface 50 of mounting table 48 so as to receive a tire 20 to mount on wheel 22. In the second position as shown in Figure 4, pivot arm 54 is substantially parallel to mounting surface 50 of mounting table 48.

Fingers 62 are opened and closed by pneumatic actuators that are controlled by a logic control system of the type that is well-known and understood by those skilled in the art. Fingers 62 are in the open position when pivot arm 54 is in the first position to receive a tire therebetween. The pneumatic actuators thereafter cause fingers 62 to close on tire 20 to secure tire 20 in the grip end 60 of pivot arm 54. Preferably fingers 62 clamp on an angular sector $\varnothing_1$ of tire 20 that is defined between angular positions marked by radiuses R_1 and R_2 of tire 20. Pivot arm 54 is then swung through an arc as shown in Figures 2 and 3 into the second position shown in Figure 4.

When pivot arm 54 is in the second position with fingers 62 closed, the pivot end 56 of pivot arm 54 is moved from the open position shown in Figure 4 to the closed position as shown in Figure 5 and as herein previously described. The movement of pivot arm 54 from the first position to the second position moves tire 20 into a position over wheel 22 such that a portion of wheel 22 protrudes through porthole 33 of tire 20 and the angular sector $\varnothing_1$ of tire 20 that is

defined between first radius R_1 and second radius R_2 is located laterally between the inner and outer bead retainer flanges 42 and 44 of wheel 22.

The pivot arm 54 is then moved from the open position shown in Figure 4 to the closed position shown in Figure 5 to cause bead surfaces 30 and 32 within sector $\varnothing_1$ to enter well 40 that is defined by wheel 22 and to contact wheel 20 between the inner bead retainer flange 42 and the outer bead retainer flange 44.

The tire changing device further includes a press arm or a button arm 66. Button arm 66 is slidingly connected to frame 46 and is angularly oriented with respect to mounting table 48 at an angular position that is substantially opposite from the angular position of pivot arm 54. Button arm 66 is moveable in a direction that is generally normal with respect to mounting surface 50 of mounting table 48. Button arm 66 includes a press end 68 that is moveable between a raised position as shown in Figures 1-5 and a lowered position as shown in Figure 7. In the raised position of Figures 1-5, press end 68 is separated from said mounting surface 50 by a distance that is greater than the normal distance between the upper bead retainer flange 44 of wheel 22 and mounting surface 50 of mounting table 48. In the lowered position of Figure 7, the normal separation between press end 68 and mounting surface 50 is less than the dimension between the upper bead retainer flange 44 and mounting surface 50.

Figure 6 shows button arm 66 closing from the raised position of Figures 1-5 to the lowered position of Figure 7 with pivot arm 54 in the second position. As particularly shown in Figures 6 and 7, with pivot end 56 closing toward mounting surface 50, button arm 66 engages a second angular sector $\varnothing_2$ of tire 20 that is located between angular positions marked by radiuses R_3 and R_4 of tire 20. As shown in Figure 1, second angular sector $\varnothing_2$ is oriented on tire 20 in an angular position that is substantially opposite from the angular position of angular sector $\varnothing_1$. Button arm 66 continues to close toward mounting surface 50 so that press end 68 engages angular sector $\varnothing_2$ of tire 20 and temporarily distorts tire 20 such that the inner and outer bead surfaces 30 and 32 are drawn over outer bead retainer flange 44 and bead surfaces 30 and 32 within angular sector $\varnothing_2$ are laterally between inner bead retainer flange 42 and outer bead retainer flange 44 of wheel 22.

Thereafter, the movement of button arm 66 is reversed so that the separation between press end 68 and mounting surface 50 increases as button arm 66 returns to the raised position as shown in Figure 8. As also shown in Figure 8, fingers 62 of pivot arm 54 are opened and pivot

arm 54 is returned to its open position by moving the pivot joint 58 away from mounting table 48. In this way, tire 20 is released by the tire mounting device and, through resiliency of tire 20, allowed to return to its original shape. Thereafter, chuck 52 is removed from wheel 22 and the tire 20 is inflated to the selected pressure.

Other various embodiments of the disclosed invention will be apparent from the foregoing description. However, the disclosed invention and the method for practicing the same are not strictly limited to the particular description of the preferred embodiment, but can otherwise be variously embodied within the meaning of the following claims.